

Solange Duhamel

Professional address: Molecular and Cellular Biology, Lunar and Planetary Laboratory, BIO5 Institute, The University of Arizona, 1007 E Lowell Street, Life Sciences South 354, Tucson, AZ 85721, US

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Research Summary

I am an aquatic microbiologist and biogeochemist, specializing in the abundance, diversity and activity of aquatic microbes in the ocean, as well as in lakes, rivers, wetland ecosystems and extreme environments. I study the role of microorganisms as agents of biogeochemical transformations, and how microbes adapt to different environments and respond to stress. I am interested in the effects of climate and nutrient and energy availability on the distribution, growth and productivity of microplankton but also in the potential of life to adapt to extreme environments and the implications for astrobiology. I use experimental approaches to answer some of the most pressing questions in microbial ecophysiology and biogeochemistry. In particular, I develop and use new techniques to study microbial processes at the taxonomic group and single cell levels. So far, my work has led to the publication of forty-eight peer-reviewed journal articles and three book chapters. I have also been awarded over \$3,500,000 in grants from the National Science Foundation, the Gordon and Betty Moore Foundation and other organizations.

Academic Appointments

August 2019–Present: Associate Professor, Department of Molecular and Cellular Biology, College of Science, the University of Arizona, AZ.

August 2019–Present: Associate Professor (joint appointment) BIO5 Institute, College of Science, the University of Arizona, AZ.

April 2021–Present: Associate Professor (joint appointment) in the Department of Planetary Sciences/Lunar and Planetary Laboratory (LPL), College of Science, the University of Arizona, AZ.

August 2020–Present: Adjunct Research Scientist, Lamont-Doherty Earth Observatory of Columbia University, NY.

January 2014–present: Research Associate, American Museum of Natural History, NY.

January 2017–August 2019: Associate Research Professor Junior Staff, promoted to Associate Research Professor Senior Staff (tenure equivalent), Lamont-Doherty Earth Observatory of Columbia University, NY.

September 2012–2016: Assistant Research Professor, Lamont-Doherty Earth Observatory of Columbia University, NY.

Professional experience

**Recipient of a competitive scholarship.*

October 2011–August 2012:

- Devonshire postdoctoral scholar* at the Woods Hole Oceanographic Institution (WHOI, <http://www.whoi.edu/>).
- Part time postdoctoral research fellow at Lamont-Doherty Earth Observatory of Columbia University (<http://www.ldeo.columbia.edu/>).

January 2008–September 2011: Postdoctoral fellow within the Center for Microbial Oceanography: Research and Education (C-MORE, <http://cmore.soest.hawaii.edu/>) at the University of Hawaii, Dr. David M. Karl Laboratory.

February–September 2004: Laboratory assistant – INRA Laboratory of Aquatic Microbiology (Thonon-les-Bains, France, <http://www.thonon.inra.fr/>). *Supervisor:* Dr. Stéphane Jacquet.

Master thesis: “Quantitative and functional analysis of bacteriophages in Lake Geneva: method comparisons and estimates of protozoan and virus-mediated mortality of bacterioplankton”.

July–August 2002 and May 2003: Laboratory assistant – Oceanology Observatory of Banyuls-sur-Mer (Banyuls-sur-Mer, France, <http://www.obs-banyuls.fr/Index.htm>). *Supervisor:* Dr. François Lantoine.

Bachelor thesis: “Effect of UV radiations on 4 strains of *Synechococcus* (Cyanobacteria)”.

Education

**Recipient of a competitive scholarship*

2004–2007: Ph.D. in Marine Environmental Science, University of Aix-Marseille II.

Defense: October 22nd 2007 – Very honorable distinction

Dissertation title: “Role of heterotrophic bacteria and primary producers in the phosphorus cycling: coupling between carbon and phosphate fluxes in relation with the functional community structure”

Advisors: Dr. Thierry Moutin and Dr. France Van Wambeke

Committee: Dr. Tron Frede Thingstad, Dr. Jean-Pascal Torréton, Dr. Bernard Quéguiner, Dr. Hervé Claustre, and Dr. Jiří Nedoma

2002–2004: M.Sc. in Biological Oceanography and Marine Environmental Ecology, *Specialization:* Phytoplankton Ecology, University Pierre & Marie Curie, Paris VI

1999–2002: B.Sc. in Organisms Biology, *Specialization:* Ecology and Phycology, University Pierre & Marie Curie, Paris VI

Scientific publications

** Denotes students that I supervised and or trained.*

*** Denotes post-doc that I supervised and or trained.*

♦ Denotes corresponding authors

∇ Denotes first co-authors

Manuscripts in preparation (Draft available upon request)

1. **Duhamel♦ S.**, Hamilton C.W., Björnsdóttir S., and S. Pálsson. Microbial response to increased temperatures within a lava-induced hydrothermal system in Iceland as an analog for Mars – in preparation for *Astrobiology*
2. Djaoudi**♦ K., Diaz J.M., Plummer S., Steffen R., Waggoner* E.M., and **S. Duhamel♦**. Role of selected dissolved organic phosphate compounds metabolism within the marine microbial P cycle – in preparation for *Progress in Oceanography*
3. Waggoner* E.M., **Duhamel♦ S.**, Djaoudi**♦ K., and J.M. Diaz. Dissolved organic phosphorus utilization by marine *Synechococcus* – in preparation for *Frontiers in Marine Sciences*
4. Paasch* A., Burns** J.A., Favate* J., Bock* N., Anderson O.R., **Duhamel S.**, and E. Kim. Nutritional aspects of bacterivory in a green algal mixotroph. – in preparation for *Microbial Ecology*

Manuscripts submitted or in revision

1. Berthelot*** H., **Duhamel S.**, L’Helguen S., Maguer J.F., and N. Cassar*. Inorganic and organic carbon and nitrogen uptake strategies of picoplankton groups in the northwestern Atlantic Ocean. *Limnology and Oceanography*. In revision
2. Bock** N.A., Subramaniam A., Juhl A. Montoya J., and **S. Duhamel***. A method for measuring per-cell chlorophyll a in natural picophytoplankton populations using fluorescence-activated cell sorting. *Limnology and Oceanography: Methods*. In revision
3. Charvet*** S., Duhamel* S., Kim E., Subramanian A., and J. Montoya. Photosynthetic picoeukaryote assemblages of the Northwest Atlantic are stable despite the dynamic Amazon River Plume. *Scientific Reports*. Submitted

Published publications (peer reviewed)

48. **Duhamel**[∇]* S., J.M Diaz[∇], J.C. Adams, K. Djaoudi*, V. Steck, E.M. Waggoner*. Phosphorus: an integral component of global marine biogeochemistry. *Nature Geosciences*. In press
47. Bock[∇]* N.A., Charvet[∇]*** S., Burns** J., Gyaltsen Y., Rozenberg A., **Duhamel*** S., and E. Kim*. 2021. Experimental identification and in silico prediction of bacterivory in green algae. *The ISME Journal*. <https://doi.org/10.1038/s41396-021-00899-w>
46. Burns*** J.A., Kerney R.R., and **S. Duhamel**. 2020. Heterotrophic carbon fixation in a salamander-alga symbiosis. *Frontiers in Microbiology*, section Microbial Symbioses, 11, 1815. doi: 10.3389/fmicb.2020.01815
45. Benavides* M., **Duhamel S.**, Van Wambeke F., Shoemaker K.M., Moisander P.H., Salamon E., Riemann L., and S. Bonnet. 2020. Dissolved organic matter stimulates N₂ fixation and *nifH* gene expression in *Trichodesmium*. *FEMS Microbiology Letters*, 367(4), fnaa034. doi.org/10.1093/femsle/fnaa034
44. Bonnefoy L.E., Hamilton* C.W., Scheidt S.P., **Duhamel S.**, Hoskuldsson Á., Jonsdottir I., Thordarson T., and U. Münzer. 2019. Landscape evolution associated with the 2014–2015 Holuhraun eruption in Iceland. *Journal of Volcanology and Geothermal Research*, 387, 106652, doi:10.1016/j.jvolgeores.2019.07.019
43. Shoemaker* K. M., **Duhamel S.** and P. H. Moisander*. 2019. Copepods promote bacterial community changes in surrounding seawater through farming and nutrient enrichment. *Environmental Microbiology*, 21(10), 3737–3750, doi:10.1111/1462-2920.14723
42. **Duhamel*** S., E. Kim, B. Sprung, and O. R. Anderson. 2019. Small pigmented eukaryotes play a major role in carbon cycling in the P-depleted western subtropical North Atlantic, which may be supported by mixotrophy. *Limnology and Oceanography*, 64, 2424–2440, doi:10.1002/lno.11193
41. Diaz* J.M., Steffen R., Sanders J.G., Tang Y., and **S. Duhamel**. 2019. Preferential utilization of inorganic polyphosphate over other bioavailable phosphorus sources by the model diatoms *Thalassiosira* spp. *Environmental Microbiology*, 21, 2415–2425, doi: 10.1111/1462-2920.14630
40. Berthelot* H., **Duhamel S.**, L’Helguen S., Maguer J.F., Wang S., and N. Cassar*. 2019. NanoSIMS single cell analyses reveal the contrasting nitrogen sources for small phytoplankton. *The ISME Journal* 13:651–662, doi: 10.1038/s41396-018-0285-8
39. Diaz* J.M., Holland A., Sanders J.G., Bulski K., Mollett D., Chou C-W., Phillips D., Tang Y., And **S. Duhamel**. 2018. Dissolved organic phosphorus utilization by phytoplankton reveals preferential degradation of polyphosphates over phosphomonoesters. *Frontiers in Marine Sciences*, 5(380), doi: 10.3389/fmars.2018.00380
38. Dupouy* C., Frouin R., Tedetti M., Maillard M., Rodier M., Lombard F., Guidi L., Picheral M., **Duhamel S.**, Charrière B., and R. Sempéré. 2018. Diazotrophic *Trichodesmium* impact on UV–Vis radiance and pigment composition in the western tropical South Pacific. *Biogeosciences*, 15, 5249–

- 5269, doi: 10.5194/bg-15-5249-2018
37. Bock*♦ N.A., Van Wambeke F., Dion* M., and **S. Duhamel**. 2018. Microbial community structure in the western tropical South Pacific. *Biogeosciences*, 15, 3909-3925, 10.5194/bg-15-3909-2018
 36. Björkman♦ K.M., **S. Duhamel**, M.J. Church and D.M. Karl. 2018. Spatial and temporal dynamics of inorganic phosphate and adenosine-5'-triphosphate in the North Pacific Ocean. *Frontiers in Marine Science*, 5(235), doi: 10.3389/fmars.2018.00235
 35. Van Wambeke♦ F., Gimenez* A., **Duhamel S.**, Dupouy C., Lefevre D., Pujo-Pay M., and T. Moutin. 2018. Dynamics and controls of heterotrophic prokaryotic production in the western tropical South Pacific Ocean: links with diazotrophic and photosynthetic activity. *Biogeosciences*, 15, 2669–2689, doi: 10.5194/bg-15-2669-2018
 34. Benavides♦ M., Shoemaker K.M., Moisander P.H., Niggemann J., Dittmar T., **Duhamel S.**, Grosso O., Pujo-Pay M., Hélias-Nunige S., and S. Bonnet. 2018. Aphotic N₂ fixation along an oligotrophic to ultraoligotrophic transect in the Western Tropical South Pacific Ocean. *Biogeosciences*, 15, 3107–3119, doi: 10.5194/bg-15-3107-2018
 33. **Duhamel♦ S.**, Van Wambeke F., Lefevre D., Benavides M., and S. Bonnet. 2018. Mixotrophic metabolism by natural communities of unicellular cyanobacteria in the western tropical South Pacific Ocean. *Environmental Microbiology*, 20(8), 2743–2756, doi:10.1111/1462-2920.14111
 32. Rousselet♦ L., de Verneil A., Doglioli A.M., Petrenko A.A., **Duhamel S.**, Maes C., and B. Blanke. 2018. Large- to submesoscale surface circulation and its implications on biogeochemical/biological horizontal distributions during the OUTPACE cruise (southwest Pacific). *Biogeosciences*, 15, 2411–2431, doi: 10.5194/bg-15-2411-2018
 31. **Duhamel♦ S.**, Björkman K.M., Repeta D.J. and D.M. Karl. 2017. Phosphorus dynamics in biogeochemically distinct regions of the southeast subtropical Pacific Ocean. *Progress in Oceanography*, 151, 261–274, doi: 10.1016/j.pocean.2016.12.007
 30. Benavides♦ M., Berthelot H., Raimbault P., **Duhamel S.**, S. Bonnet. 2017. Dissolved organic matter uptake by *Trichodesmium* in the Southwest Pacific. *Nature Scientific Reports*, 7, 41315, doi: 10.1038/srep41315 (2017)
 29. **Duhamel♦ S.**, Nogaro** G., and A.D. Steinman. 2017. Effects of water level fluctuation and sediment–water nutrient exchange on phosphorus biogeochemistry in two Great Lakes coastal wetlands. *Aquatic Sciences*, 79(1), 57-72, doi: 10.1007/s00027-016-0479-y
 28. Kim♦ E., Sprung B., **Duhamel S.**, Filardi C., M.K. Shin. 2016. Oligotrophic lagoons of the South Pacific Ocean are home to a surprising number of novel eukaryotic microorganisms. *Environmental Microbiology*, 18(12), 4549–4563. doi: 10.1111/1462-2920.13523
 27. Rii♦ Y.M., **Duhamel S.**, Bidigare R.R., Karl D.M., Repeta D., and M.J. Church. 2016. Diversity and productivity of photosynthetic picoeukaryotes in biogeochemically distinct regions of the South East Pacific Ocean. *Limnology and Oceanography*, 61: 806–824, doi:10.1002/lno.10255
 26. Popendorf***♦ K., and **S. Duhamel**. 2015. Variable phosphorus uptake rates and allocation across microbial groups in the oligotrophic Gulf of Mexico. *Environmental Microbiology*, 17(10): 3992–4006. doi:10.1111/1462-2920.12932
 25. **Duhamel♦ S.**, Björkman K.M., Doggett J.K., and D.M. Karl. 2014. Microbial response to enhanced phosphorus cycling in the North Pacific Subtropical Gyre. *Marine Ecology Progress Series*, 504: 43–58, doi:10.3354/meps10757
 24. Sharma♦ A.K., Becker J.W., Ottesen E.A., Bryant J.A., **Duhamel S.**, Karl D.M., Cordero O.X., Repeta D.J. and E.F. DeLong♦. 2013. Distinct dissolved organic matter sources induce rapid transcriptional responses in coexisting populations of *Prochlorococcus*, *Pelagibacter* and the OM60 Clade. *Environmental Microbiology*, 16(9): 2815–2830, doi:10.1111/1462-2920.12254
 23. **Duhamel♦ S.**, Björkman K.M., and D.M. Karl. 2012. Light dependence of phosphorus uptake by

- microorganisms in the subtropical North and South Pacific Ocean. *Aquatic Microbial Ecology*, 67: 225–238, doi:10.3354/ame01593
22. Björkman♦ K.M., **Duhamel S.**, and D.M. Karl. 2012. Microbial group specific uptake kinetics of inorganic phosphate and adenosine-5'-triphosphate (ATP) in the North Pacific Subtropical Gyre. *Frontiers in Microbiology* 3(189): 1–17
 21. Guidi♦ L., Calil P. H. R., **Duhamel S.**, Björkman K. M., Doney S. C., Jackson G. A., Li B., Church M. J., Tozzi S., Kolber Z. S., Richards K. J., Fong A. A., Letelier R. M., Gorsky G., Stemman L., and D. M. Karl. 2012. Does eddy-eddy interaction control surface phytoplankton distribution and carbon export in the North Pacific Subtropical Gyre? *Journal of Geophysical Research*, 117, G02024, doi:10.1029/2012JG001984
 20. Talarmin♦ A., Van Wambeke F., **Duhamel S.**, Catala P., Moutin T., and P. Lebaron. 2011. Improved methodology to measure taxon-specific phosphate uptake in live and unfiltered samples. *Limnology and Oceanography: Methods*, 9: 443–453. doi:10.4319/lom.2011.9.443
 19. **Duhamel♦ S.**, Björkman K.M., Van Wambeke F., Moutin T., and D.M. Karl. 2011. Characterization of alkaline phosphatase activity in the North and South Pacific subtropical gyres: implication for the phosphorus cycle. *Limnology and Oceanography*, 56(4): 1244–1254 doi:10.4319/lo.2011.56.4.1244
 18. **Duhamel♦ S.**, Dyhrman S.T., and D.M. Karl. 2010. Alkaline phosphatase activity and regulation in the North Pacific Subtropical Gyre. *Limnology and Oceanography*, 55(3): 1414–1425. doi:10.4319/lo.2010.55.3.1414
 17. Van Wambeke♦ F., Tedetti M., **Duhamel S.**, and R. Sempéré. 2009. Diel variability of heterotrophic bacterial production and underwater UV doses in the eastern South Pacific. *Marine Ecology Progress Series*, 387: 97–108. doi:10.3354/meps08075
 16. **Duhamel♦ S.**, Gregori G., Van Wambeke F., and J. Nedoma. 2009. Detection of extracellular phosphatase activity of heterotrophic prokaryotes at the single cell level by flow cytometry. *Current Protocols in Cytometry*, 49: 11.18.1–11.18.8. doi:10.1002/0471142956.cy1118s49
 15. **Duhamel♦ S.**, Gregori G., Van Wambeke F., and J. Nedoma. 2009. Detection of extracellular phosphatase activity at the single cell level by enzyme-labelled fluorescence and flow cytometry: the importance of time kinetics in ELFA labelling. *Cytometry: Part A*. 75A: 163–168. doi:10.1002/cyto.a.20686
 14. **Duhamel♦ S.**, and T. Moutin. 2009. Carbon and phosphate incorporation rates of microbial assemblages in contrasting environments in the Southeast Pacific. *Marine Ecology Progress Series*, 375: 53–64. doi:10.3354/meps07765
 13. **Duhamel♦ S.**, Gregori G., Van Wambeke F., Mauriac* R., and J. Nedoma. 2008. A method for analysing phosphatase activity in aquatic bacteria at the single cell level using flow cytometry. *Journal of Microbiological Methods*, 75: 269–278. doi:10.1016/j.mimet.2008.06.018
 12. Van Wambeke♦ F., Nedoma J., **Duhamel S.**, and P. Lebaron. 2008. Alkaline phosphatase activity of marine bacteria studied with ELF97 phosphate: Success and limits in P-limited Mediterranean Sea. *Aquatic Microbial Ecology*, 52: 245–251. doi:10.3354/ame01238
 11. Van Wambeke♦ F., Obernosterer I., Moutin T., **Duhamel S.**, Ulloa O. and H., Claustre. 2008. Heterotrophic bacterial production in the eastern South Pacific: longitudinal trends and coupling with primary production. *Biogeosciences*, 5: 157–169
 10. Van Mooy♦ B., Moutin T., **Duhamel S.**, and F. Van wambeke. 2008. Phospholipid synthesis rates in the eastern subtropical South Pacific Ocean. *Biogeosciences*, 5, 133–139
 9. Moutin♦ T., Karl D.M., **Duhamel S.**, Rimmelin P., Raimbault P., Van Mooy B., and H. Claustre. 2008. Phosphate availability and the ultimate control of new nitrogen input by nitrogen fixation in the tropical Pacific Ocean. *Biogeosciences*, 5: 95–109
 8. **Duhamel♦ S.**, Moutin T., Van Mooy B., Van Wambeke F., and H. Claustre. 2007. Growth and specific P-uptake rates of bacterial and phytoplanktonic communities in the Southeast Pacific

- (BIOSOPE cruise). *Biogeosciences*, 4, 941–956
7. Nedoma♦ J., Van Wambeke F., Strojsova A., Strojsova M., and **S. Duhamel**. 2007. Affinity of extracellular phosphatases for ELF 97 phosphate in aquatic environments. *Marine and Freshwater Research* 58(5): 454–460. doi:10.1071/MF06211
 6. **Duhamel♦ S.**, Zeman F., and T. Moutin. 2006. A dual-labeling method for the simultaneous measurement of dissolved inorganic carbon and phosphate uptake by marine planktonic species. *Limnology and Oceanography: Methods* 4: 416–425. doi:10.4319/lom.2006.4.416
 5. Personnic S., **Duhamel S.**, Bettarel Y., Sime-Ngando T., and S. Jacquet♦. 2006. Les virus planctoniques : un compartiment biologique clef des milieux aquatiques, *Le Courrier de l'Environnement de l'INRA*, 53: 19–34
 4. **Duhamel S.**, Domaizon I., Personnic S., and S. Jacquet♦. 2006. Assessing the microbial community dynamics and the role of bacteriophages as mortality agents in Lake Geneva. *Journal of water science* 19(2): 115–126. doi:10.7202/013045ar
 3. **Duhamel S.**, and S. Jacquet♦. 2005. Flow cytometric analysis of bacteria- and virus-like particles in lake sediments. *Journal of Microbiological Methods* 64(3): 316–332. doi:10.1016/j.mimet.2005.05.008
 2. Jacquet♦ S., Domaizon I., Personnic S., Pradeep-Ram A.S., Heldal M., **Duhamel S.**, and T. Sime-Ngando. 2005. Estimates of protozoan- and viral-mediated mortality of bacterioplankton in Lake Bourget (France). *Freshwater Biology* 50: 627–645. doi:10.1111/j.1365-2427.2005.01349.x
 1. **Duhamel S.**, Personnic S. and S. Jacquet♦. 2005. Importance des virus en milieu lacustre. *INRA mensuel* 122: 8–9

Book chapters

3. Cade-Menun, B., **S. Duhamel**, R. Dodds, C. Lonborg, C.T. Parsons, and W.D. Taylor. 2019. Editorial: Phosphorus Along the Soil-Freshwater-Ocean Continuum. *Frontiers in Marine Science*, section Marine Biogeochemistry. Edited by: Eric Pieter Achterberg. E-book. Volume 6, issue 28
2. Steinman A.D., and **S. Duhamel**. 2017. Phosphorus Limitation, Uptake, and Turnover in Benthic Stream Algae. *Methods in Stream Ecology (Third Edition)*. Academic Press. pp 197–218
1. Grégori, G., M. Denis, **S. Duhamel**, and F. Wambeke. 2011. Analysis of Phosphatase Activity from Aquatic Heterotrophic Bacteria at the Single Cell Level by Flow Cytometry: Example of a Development Achieved in the Regional Flow Cytometry Platform for Microbiology (Precym) Hosted by the Oceanology Center of Marseille, p. 255-258. In H.-J. Ceccaldi, I. Dekeyser, M. Girault and G. Stora [eds.], *Global Change: Mankind-Marine Environment Interactions*. Springer Netherlands. doi:10.1007/978-90-481-8630-3_44

Publications for the general public and education

1. **Duhamel S.**, and C.W. Hamilton. 2021. How microbes in Iceland can teach us about possible life on Mars? *Futurum Careers*. Issue 7, pp 22–25. doi: 10.33424/FUTURUM112. ISSN 2632-8380

Scientific presentations

Invited seminars

- Duhamel, S.** What can marine microbes tell us about the potential for life on ocean worlds? Lunar and Planetary Laboratory Colloquium, University of Arizona, February 23rd, 2021, Tucson, AZ.

- Duhamel, S.** New insights into the metabolism of marine picoplankton using single-cell approaches. CFAM Seminar series, Arizona State University, June 11th, 2020, Tempe, AZ.
- Duhamel, S.** Organic matter metabolism by picophytoplankton in oligotrophic marine environments. Ecology and Evolutionary Biology seminar, University of Arizona, January 21st, 2020, Tucson, AZ.
- Duhamel, S.** Metabolism of the smallest marine phytoplankton in oligotrophic environments. MCB joint seminar, University of Arizona, December 10th, 2019, Tucson, AZ.
- Duhamel, S.** Studying organic matter utilization by the smallest marine phytoplankton, one cell at a time. Lamont-Doherty Earth Observatory - Special seminar. September 25th 2019, Palisades, NY.
- Duhamel, S.** Phosphorus, the staff of life: Aquatic microorganisms' strategies in the face of phosphate scarcity. Gordon Research Conferences Origins of Life, January 16th, 2018, Galveston, TX
- Duhamel, S.** Oligotrophic Marine microbes: nutrient-limited extremophiles and their role in seawater chemistry on Earth and beyond. The University of Arizona Department of Molecular & Cellular Biology seminar, June 27th, 2017, Tucson, AZ.
- Duhamel, S.** Marine microbes: Strategies for optimizing growth in the face of nutrient limitation. The University of Arizona Geosciences Colloquium Series, October 20th, 2016, Tucson, AZ.
- Duhamel, S.** Microbial phosphorus utilization in oligotrophic marine environments. Bigelow Laboratory for Ocean Sciences Seminar, September 22nd, 2016, East Boothbay, MN.
- Duhamel, S.** Marine microbial phosphorus cycling: what have we learned using single-cell approaches? Villefranche Oceanographic Laboratory seminar series, Sorbonne University, November 23rd, 2015, Villefranche-sur-Mer, France.
- Duhamel, S.** Marine biogeochemistry: Scaling to the microbe's-eye view of processes using flow cytometry. American Museum of Natural History seminar series, January 13th, 2014, New York, NY.
- Duhamel, S.** Phosphorus resource partitioning in the open ocean: new insights from single cell approaches. Grand Valley State University's Annis Water Resources Institute seminar series, November 2nd 2012, Muskegon, MI.
- Duhamel, S.** Phosphorus resource partitioning in the North Pacific subtropical gyre: new insights from single cell approaches. Woods Hole Oceanographic Institution - Biology seminar, May 10th 2012, Woods Hole, MA.
- Duhamel, S., K. Björkman, D. Karl.** Light dependence of phosphorus uptake by microorganisms in the North and South Pacific subtropical gyres. 5th International Conference on Analysis of Microbial Cells at the Single Cell Level. November 5–8 2011, Carry-le-Rouet, France.
- Duhamel, S.** Interactions between element cycles and microbial community structure, Lamont-Doherty Earth Observatory - Division of Biology and Paleo Environment seminar. April 29th 2011, Palisades, New York.
- Duhamel, S.** C-MORE 2010 cruise: exploring gradients from the South-East Pacific Ocean. C-MORE webcast seminar: Avoiding Collapse – the Easter Island Way. November 4th 2010, Honolulu, Hawaii.
- Duhamel, S.** Phosphorus cycling in the North Pacific Subtropical Gyre. Center of Oceanology of Marseille seminar session. September 27th 2010, Marseille, France.
- Duhamel, S.** Interaction between elements cycling and microbial community structure: cellular and molecular approaches. Center of Oceanology of Marseille seminar session March 16th 2009. Marseille, France.

Professional presentations (selected since 2017)

****** *Denotes students and post-doc that I supervised*

- Burns**, J. A., H. Yang**, R. Adikes, C. Loussert, R. T. Williamson, B. Genot, W. Strangman, C. Alves-de-Souza, D. Q. Matus, **S. Duhamel**, R. Kerney. When plants and animals become one: Organismal and cellular interactions in a vertebrate-alga symbiosis. Minisymposium “Evolution and Emerging Models”, at the Cell Bio Virtual 2020 Meeting. December 2–16, 2020, TALK
- Ramcharitar**, B., **S. Duhamel**, E. Stropped, J. Montoya, A. Subramaniam. Microbial Community Structure in the Amazon River Plume. Ocean Sciences Meeting. February 16–21, 2020, POSTER
- Djaoudi**, K., S. plummer, R. Steffen, E. Waggoner, J.M. Diaz, **S. Duhamel**. Bioavailability of representative dissolved organic phosphate compounds to microbial communities in the western North Atlantic. Ocean Sciences Meeting. February 16–21, 2020, POSTER
- Duhamel S.**, Waggoner**, E., J.M. Diaz. Dissolved Organic Phosphorus Utilization by *Synechococcus*. Ocean Sciences Meeting. February 16–21, 2020, POSTER
- Bock**, N., A. Subramaniam, A. Juhl, J. Montoya, **S. Duhamel**. Determining cell-specific chlorophyll-a of picophytoplankton using fluorescence-activated cell sorting. Ocean Sciences Meeting. February 16–21, 2020, POSTER
- Burns**, J., R. Kerney, R. Adikes, D. Matus, **S. Duhamel**. Carbon fixation by embryonic salamanders during a vertebrate-alga symbiosis. Gordon Research Conference on Animal-Microbe Symbioses as Nested Ecosystems. June 16–21, 2019, POSTER
- Muñoz-Marín**, M., **S. Duhamel**, K. Björkman, D. M. Karl, J. Díez, J.M. García-Fernández. Effects of glucose addition to natural *Prochlorococcus* populations at Station ALOHA, Hawaii. The 13th Workshop on Cyanobacteria, Boulder, CO. June 6–9, 2019, POSTER
- Muñoz-Marín**, M., **S. Duhamel**, K. Björkman, D. M. Karl, J. Díez, J.M. García-Fernández. Carbon assimilation in *Prochlorococcus* during diel cycles at Aloha Station, Hawaii. Gordon Research Conference on Marine Microbes, Lucca (Barga), Italy. July 1–6, 2018, POSTER
- Holland**, A., J.G. Sanders, D. Mollett, **S. Duhamel**, Y. Tang, J.M. Diaz. Compound-specific degradation of phosphorus sources by the marine diatoms *Thalassiosira spp.* Goldschmidt Conference, Boston, MA. August 12–17 2018, POSTER
- Duhamel, S.**, F. Van Wambeke, D. Lefevre, M. Benavides, S. Bonnet, T. Moutin. Assimilation of organic carbon and nutrient substrates by unicellular cyanobacteria: evaluating the importance of photoheterotrophy in natural communities of the topical southwest Pacific. ASLO Aquatic Sciences Meeting, Honolulu, HI. February 26 – March 3 2017

Scholarships, grants and awards

** Denotes students and post-doc that I supervised

Current

- 2021** • **NSF GG award #:** “RAPID: Initial colonists of freshly emplaced volcanic rocks at high latitude: a case study of the 2021 volcanic eruption on the Reykjanes Peninsula, Iceland” [\$45,873 for 1 year to **S. Duhamel**]. Anticipated end date: 03/31/2022.
- **RII award** (University of Arizona): “Response to the 2021 volcanic unrest in Reykjanes, Iceland” [\$20,000 to C. Hamilton and **S. Duhamel**]
- 2020** • **Gordon and Betty Moore Foundation award #5604 – Supplement Funding:** “Solar Salamanders? Algal Invasion of a Vertebrate” [including \$97,070 to **S. Duhamel** for 1 year]. Anticipated end date: 08/31/2022.
- 2020** • **Scialog Fellow** (jointly sponsored by RCSA and the Heising-Simons Foundation, with additional support from the Kavli Foundation)
- 2019** • **NSF OCE award #2001212:** “Collaborative Research: Assessing the role of compound-specific

phosphorus hydrolase transformations in the marine phosphorus cycle” \$499,786 for 3 years to **S. Duhamel** (U. of Arizona). Anticipated end date: 08/31/2022.

- 2019** • **Faculty innovator Award** (University of Arizona, College of Sciences, MCB, \$5,000)
- **Gordon and Betty Moore Foundation award #5604**: “Solar Salamanders? Algal Invasion of a Vertebrate” [To R. Kerney (Gettysburg College), **S. Duhamel** (University of Arizona), J. Burns (Bigelow Lab.) and D. Matus (Stony Brooks), with \$226,249 for 2 years to **S. Duhamel**]. Anticipated end date: 08/31/2021.
- 2017** • **NSF OCE award # 1737240**: “Development of low Nitrogen:Phosphorus ratios in the euphotic zone - the Phosphorus side of the story” [\$1,417,633 for 3 years to A. Juhl, **S. Duhamel**, A. Subramaniam, and A. Thurnherr (all investigators at Columbia U.)]. Anticipated end date: 12/31/2021.

Past

- 2018** • **Palisades Geophysical Institute (PGI) Young Scientist Chair Award** (\$72,000 for 2 years)
- 2017** • **Gordon and Betty Moore Foundation award #5604**: “Solar Salamanders? Algal Invasion of a Vertebrate” [To R. Kerney (Gettysburg College), **S. Duhamel** (Columbia U.), J. Burns (AMNH) and D. Matus (Stony Brooks) for a total of \$1,031,671 for 3 years, with \$344,000 to **S. Duhamel**]
- **NSF OCE award # 1737240**: “Development of low Nitrogen:Phosphorus ratios in the euphotic zone - the Phosphorus side of the story” [\$1,417,633 for 3 years to A. Juhl, **S. Duhamel**, A. Subramaniam, and A. Thurnherr (all investigators at Columbia U.)]. Anticipated end date: 12/31/2021.
 - **NSF OCE award #1737083**: “Collaborative Research: Assessing the role of compound-specific phosphorus hydrolase transformations in the marine phosphorus cycle” [\$556,075 for 3 years to **S. Duhamel** (Columbia U.), and \$296,831 to Julia Diaz (U. of Georgia)]
- 2015** • **NSF OCE award #1458070**: “Collaborative Research: Role of small-sized protists in the microbial loop with emphasis on interactions between mixotrophic protists and picocyanobacteria” [\$530,768 for 3 years to **S. Duhamel**, with O.R. Anderson (Columbia U.) and \$ 80,606 to E. Kim (AMNH)]
- **Columbia Climate Center award**: “Assessing the effect of climate warming on phosphorus scavenging and on nitrogen fixation by unicellular diazotrophic cyanobacteria” [\$9,650 for 2 years to **S. Duhamel** (Columbia U.)]
- 2014** • **NSF OCE award #1434916**: "Photoheterotrophy in unicellular cyanobacteria: ecological drivers and significance for marine biogeochemistry" [\$334,185 for 3 years to **S. Duhamel** (Columbia U.)]
- **NSF OCE award #1434914**: “Role of variable picoplankton cellular phosphorus turnover and allocation in marine phosphorus cycling” [\$234,419 for 2 years to **S. Duhamel** and K. Pependorf** (Columbia U.)]
 - **Columbia Climate Center award**: “Assessing factors controlling the elemental composition of key phytoplankton groups in the context of climate change” [\$9,000 for 3 years to **S. Duhamel** (Columbia U.)]
- 2013** • **Robert B. Annis Water Resources Institute Grant**: “Will changes in water level fluctuation alter coastal wetland ecosystem structure and function?” [\$6,000 for 1 year to **S. Duhamel** (Columbia U.)]

- 2011** • **Devonshire Postdoctoral scholarship** from the Woods Hole Oceanographic Institution [\$84,000 for 18 months to **S. Duhamel** (WHOI)]
- 2009** • **EdVenture Grant:** "Characterization of high affinity P acquisition gene expression and regulation in oligotrophic environments" [\$13,716 for 2 years to **S. Duhamel** (U. of Hawaii)]
- 2008** • **Distinguished Doctoral Dissertation Award** of the Mediterranean University (France).
- 2004** • **Ministry of National Education, Research and Technology Graduate Scholarship** from the French Government (for 3 years)

Pending

- **NSF - Biology Integration Institutes:** “Collaborative Research: BII Implementation: Pelagic Ecosystem Research - Structure, Emergent fUNCTIONS, and Synergies (PERSEUS)”. PIs Duhamel (UA), S. Joye et al. (U. Georgia), amount requested for Duhamel: \$750,832. Submitted in January 2021. Response expected in June-July 2021.
- **Provost's Investment Fund (PIF):** “Growing Astrobiology at the University of Arizona: Infrastructure and Educational Opportunities in Planetary Analog Research”. PIs S. Duhamel and C. Hamilton, amount requested: \$152,592. Submitted in January 2021. Response expected in spring 2021.
- **NASA-FINESST:** “Investigating the Habitability of Lava-Induced Mars Analog Hydrothermal Systems”. PI S. Duhamel, co-Is C. Hamilton and N. Hadland, amount requested: \$135,000. Submitted in February 2021. Response expected in June-July 2021.
- **CNRS-UArizona IRC Graduate Fellowship Program:** “Alternative sources of phosphorus: the missing link between marine primary productivity and nitrogen budgets”. PI Duhamel (UA) and S. Rabouille (LOB), amount requested for Duhamel: \$135,000. Submitted in February 2021. Response expected in spring 2021.

Teaching and mentoring

‡ *Denotes Underrepresented Students in STEM*

Teaching

- 2020** Instructor for the University of Arizona (these are two new courses that I developed):
 - MCB 437-537 “Life in extreme environments” (3 credits graduate course opened to undergraduate students)
 - MCB 295G “Life in the Universe” (1 credit colloquium for undergraduate students)
- 2019** Instructor for the University of Arizona MCB 181R “Introduction to Biology I”. (3 credits undergraduate course). Introduction to biology covers fundamental principles in molecular and cellular biology and basic genetics.
- 2014** Lecturer for the AMNH Ph.D. Program Richard Gilder Graduate School. Lectures on flow cytometry followed by hands-on demo in the lab.
- 2010–2011** Summer course teaching assistant “Microbial Oceanography: Genomes to Biomes” – C-MORE, University of Hawaii at Manoa. Lecture and laboratory practices on the analysis of low-level dissolved inorganic phosphorus in marine samples. Co-supervised the data analyses from an oceanographic cruise.

<http://cmore.soest.hawaii.edu/summercourse/2011/index.htm>;

<http://cmore.soest.hawaii.edu/agouron/2010/index.htm>

2005 Teaching assistant “Pollution” unit at the University of Aix-Marseille II.

2002–2003 French teacher for Chinese students (Paris).

Mentoring

Graduate student:

Nicholas Bock (August 2016–present; Columbia University, DEES, Ph.D. in Earth & Environmental Sciences program). Thesis title: Environmental drivers of global variability in phytoplankton community structure and function. Graduation planned for August 2021

Emily Waggoner (August 2020–present; University of Arizona, Molecular and Cellular Biology)

Nathan Hadland (August 2020–present; University of Arizona, Lunar and Planetary Laboratory)

Arizona Biological and Biomedical Sciences (ABBS) and Ecology & Evolutionary Biology (EEB) rotation programs (first year graduate students work with a PI for 3 months or a semester): Jacob Schory Copple (January–February 2020), Mruthyunjay (Jay) Kubendran Sumathi (Since January 2021).

Staff scientists: Emily Waggoner (September 2019– August 2020; University of Arizona); Emily Waggoner (January–April 2019; Columbia University); Benjamin Ramcharitar (March 2018 –August 2019; Columbia University); Kali McKee (2015–2016; Columbia University)

Postdoctoral researchers: Dr. Hui Yang (December 2019–; University of Arizona); Dr. Kahina Djaoudi (September 2019–; University of Arizona); Dr. John Burns (September 2018–July 2019; Columbia University); Dr. Sophie Charvet (January 2018–May 2019; Columbia University); Dr. Kimberly Popendorf (2013–2015; Columbia University)

Undergraduate students: Sofia Sanchez[‡] (winter 2019; Columbia University); Cassia Patel (2016–2018; Columbia University); Persis Ticknor-Swanson (2017–2018; Barnard College senior thesis); Joris Van Zeghbroeck (July–August 2016); Nicholas Bock (July–August 2016); Sarah Perché (January–June 2016); Ana Camila Gonzalez[‡] (2015–2016; Bachelor thesis; Columbia University); Moira Dion (June–July 2015; Laval University); Noel Hakoda[‡] (May–August 2010; University of Hawaii at Manoa; C-MORE scholar); William Truong[‡] (January–May 2010; University of Hawaii at Manoa; C-MORE scholar); Romain Mauriac (June–August 2006; University of the Mediterranean, Master)

High school students: Misbah Sheikh and Brianna Gibbs (summer 2018; LDEO Secondary School Field Research Program); Natalie Garbowski (Summer 2014; Tenafly High School); Malcolm LeClair and Natalie Garbowski, (Summer 2013; Tenafly High School)

1999–2004: Evening class teacher for junior high school students.

Outreach

March 20th 2021: Lecturer for Earth2Class: “Researching a vital element for life: microbial phosphorus metabolism in the ocean” <https://earth2class.org/site/?p=17157>

March 6th 2021: Volunteer at the Girls in Science and Engineering Day at the Intrepid Museum (NYC), virtual event. Graduate student Emily Waggoner and postdoctoral scientist Kahina Djaoudi prepared a video: <https://www.youtube.com/watch?v=eLSIGFP-Hm8&feature=youtu.be>

October 22nd 2019: Volunteer at the open house for high school students at the Molecular and Cellular Biology Department, the University of Arizona. <https://mcb.arizona.edu/outreach/meet-mcb>

February 19th 2019: Volunteer at the INTREPID museum annual Kids Week (NYC) <https://www.intrepidmuseum.org/kidsweek> Hands-on activities to learn about phytoplankton's adaptations to ocean acidification.

October 13th 2018: Volunteer at the Lamont-Doherty Earth Observatory open house, NY. <https://blogs.ei.columbia.edu/2018/10/18/8-awesome-exhibits-2018-lamont-open-house/>

March 24th 2018: Volunteer at the Sun-Earth Day at the American Museum of Natural History <http://www.amnh.org/learn-teach/families/hayden-planetarium-programs/sun-earth-day/> Hands-on activities to discover marine microbes' adaptations to their environment.

February 2nd 2018: Volunteer at the INTREPID museum annual Kids Week (NYC) <https://www.intrepidmuseum.org/kidsweek> Hands-on activities to discover phytoplankton's adaptations to different light environments.

March 8th 2017: Volunteer at the Sun-Earth Day at the American Museum of Natural History <http://www.amnh.org/learn-teach/families/hayden-planetarium-programs/sun-earth-day/> Hands-on activities to discover marine microbes' adaptations to their environment.

October 8th 2016: Volunteer at the Lamont-Doherty Earth Observatory open house. Hands-on activities to discover the world of marine microbes and Ocean properties.

May 6th 2016: Lecturer for Earth2Class: "Studying Phytoplankton Adaptations to Different Marine Environments". <http://earth2class.org/site/?p=9816>

February 21st 2016: Panelist for the Early Career Workshops at the Ocean Sciences Meeting in New Orleans, Louisiana, USA.

2015: Made a video to explain the objectives of the OUTPACE cruise to the public: <https://youtu.be/pT-SiEy9khQ> This video can also be found in the following blog: <http://blogs.ei.columbia.edu/2016/03/03/in-a-vast-ocean-studying-impact-of-the-tiniest-creatures/>

October 3rd 2015: Volunteer at SUBMERGE: NYC Marine Science Festival at Pier 26, NYC. Proposed hands-on activities: Build a Phytoplankton - The amazing phytoplankton! Participants build their own phytoplankton and test their biologic engineering abilities by testing to see if it floats and travels using an aquarium; Measuring salinity & map it in the Hudson - Why do salt levels vary in the Hudson. Use water samples, refractometer and a Hudson map participants will test and map salinity in the Hudson.

April 2015: Co-organized a workshop with 826NYC in which we created a Marine Biology board game with kids from underrepresented groups.

October 11th 2014: Volunteer at the Lamont-Doherty Earth Observatory open house.

April 26th 2014: Volunteer at the Northern Valley Earth Fair: C-MORE outreach kits demos.

March 22nd 2013: Panelist for the Women and Science program at Lamont-Doherty Earth Observatory.

October 6th 2012: Volunteer at the Lamont-Doherty Earth Observatory open house. <http://www.ldeo.columbia.edu/news-events/events/open-house>

March 3rd and 30th 2012: Lead the C-MORE outreach tables at the Falmouth (MA) high school and Bourne (MA) middle school science fair.

<http://www.falmouth.k12.ma.us/index.php/gallery/sciencefair/2012sciencefair/410>

Spring 2011: French voice on the C-MORE animation to understand the importance of microbes in the Ocean. <http://cmore.soest.hawaii.edu/education/animation.htm>

May 19th 2011: UH Sea Grant Hanauma Bay Education Program, public outreach series (HI): “Big Rapa Expedition: Sea It Live”. <http://www.hanaumabayeducation.org/>

February 5th 2011: Volunteer at the 3rd Leeward Regional Science Olympiad. Animate activities (HI) to engage the students and interest them in future careers in oceanography and microbial science. <http://www.hssso.org/?q=node/6>

February 4th and May 11th 2010: Volunteer to an “Ocean FEST” event. Ocean FEST is offered to participating elementary schools (grades 3–6) to interest Hawaii’s kids in careers in ocean science and related science. The program runs from 5:00 p.m. to 7:45 p.m., and begins with 30 minutes of teacher professional development. <http://oceanfest.soest.hawaii.edu/>

October 16–17 2009: Volunteer to the School of Ocean and Earth Science and Technology (SOEST) open house at the University of Hawaii at Manoa. <http://www.soest.hawaii.edu/openhouse/>

Scientific cruises – 336 days at sea as of August 2019.

GoM-2019 (EN642) – Gulf of Mexico – July 21st–August 4th, 2019.

Chief scientists: Joseph Montoya (Georgia Tech)

Objectives: The ultimate goal of this project is to understand the development of low N:P in the euphotic zone of the ocean.

Responsibilities: Conduct series of experiments related to the NSF OCE award # 1737240, focusing on phosphorus uptake and release by different groups of plankton.

ZEPHYR-2019 (Zooming in on Enzymatic PhosphoHYdrolysis Reactions, SAV1902) – Coastal Georgia – March 31st–April 12th, 2019.

Chief scientists: Julia Diaz (Skidaway Institute of Oceanography, University of Georgia)

Objectives: The ultimate goal of this project is to provide a robust understanding of the enzymatic basis involved in the transformation of specific forms of DOP and create new knowledge on the relative contribution of these specific P sources to phosphate production, marine microbial nutrition, community structure, primary productivity, and thus global carbon cycling and climate.

Responsibilities: Conduct series of experiments related to the NSF OCE award # 1737083, focusing on enzymatic phosphohydrolysis reactions in coastal environments.

GoM-2018 (EN620) – Gulf of Mexico – August 19th–September 2nd, 2018.

Chief scientists: Joseph Montoya (Georgia Tech)

Objectives: The ultimate goal of this project is to understand the development of low N:P in the euphotic zone of the ocean.

Responsibilities: Conduct series of experiments related to the NSF OCE award # 1737240, focusing on phosphorus uptake and release by different groups of plankton.

AMAZON-2018 (EN614) – Amazon river plume – May 6–June 1, 2018.

Chief scientists: Joseph Montoya (Georgia Tech)

Objectives: The ultimate objectives of this project are to understand the processes and interactions that promote distinct communities of N₂-fixing organisms (diazotrophs) and other phytoplankton around the Amazon river plume and to explore the impacts of these diazotroph-rich communities on zooplankton biomass and production.

Responsibilities: Conduct series of experiments related to the NSF OCE awards # 1737128 and # 1737083, focusing on phosphorus dynamics, especially dissolved organic phosphorus.

STEMSEAS (EN613) – Narragansett, RI, to Bridgetown, Barbados – April 27th–May 3rd 2018.

Chief scientists: Joseph Montoya (Georgia Tech)

Objectives: STEMSEAS aims to provide ship-based, exploratory experiences for undergraduates from diverse backgrounds aboard NSF-funded research vessels. *Website:*

<http://mlp.ldeo.columbia.edu/stemseas/>

HOT-296 (Hawaii Ocean Time-Series) – Station ALOHA (North Pacific subtropical gyre) – October 5–9, 2017.

Chief scientists: Fernando Santiago-Manduján (University of Hawaii)

Objectives: Scientists working on the Hawaii Ocean Time-Series (HOT) program have been making repeated observations of the hydrography, chemistry and biology of the water column at a station north of Oahu, Hawaii since October 1988. *Website:* http://hahana.soest.hawaii.edu/hot/hot_jgofs.html

Responsibilities: Conduct series of experiments related to the NSF OCE award #1434916.

BATS-Val 50 (Bermuda Atlantic Time-series Study (BATS) validation cruise), September 17–22, 2015.

Chief scientists: Rod Johnson (BIOS)

Objectives: BATS validation cruise between Bermuda and Puerto Rico.

Responsibilities: Conduct series of experiments related to the NSF OCE award # 1458070

Website: <http://www.bios.edu/research/projects/bats/>

OUTPACE (Oligotrophy to UlTra-oligotrophy PACific Experiment), February 18–April 3, 2015.

Chief scientists: Thierry Moutin and Sophie Bonnet (Mediterranean Institute of Oceanography)

Objectives: This project aims to give a zonal description of the biogeochemical functioning and biological diversity of the South West Pacific toward a gradient of macro- and micro-nutrients availability, and produce a detailed study of the biological production and its subsequent fate in 3 contrasting sites, with a specific emphasis on the production sustained by nitrogen fixation.

Responsibilities: Collect and analyze flow cytometry core samples for microbial abundances characterization. Conduct series of experiments related to the NSF OCE award #1434916.

Website: <https://outpace.mio.univ-amu.fr>

HOE-PhoR (Hawaii Ocean Experiment - Phosphorus Rally), May 22–June 5, 2013.

Chief scientists: Karin Björkman (University of Hawaii)

Objectives: conduct a series of experiments to observe and interpret the fundamental role of phosphorus in the sea, using Station ALOHA as the open ocean benchmark

Responsibilities: Characterize carbon and phosphorus dynamics at the single cell level

Website: <http://hahana.soest.hawaii.edu/hoephor/hoephor.html>

BiG RAPA (Biogeochemical Gradients: Role in Arranging Planktonic Assemblages), 14 November–14 December 2010.

Chief scientists: Dan Repeta (Woods Hole Oceanographic Institution), **Solange Duhamel** (University of Hawaii), Jamie Becker (Woods Hole Oceanographic Institution)

Objectives: Biogeochemical investigations of gradients of dissolved organic matter, energy, oxygen and light between Chile and Eastern Island.

Responsibilities: **Junior Chief Scientist:** Project and cruise organization (~1 year project).

Characterize the energy, carbon and phosphorus fluxes along nutrient and biomass gradients.

Website: http://cmore.soest.hawaii.edu/cruises/big_rapa/index.htm

“Diazotrophs and pCO₂” (KM10-16), 20–30 August 2010.

Chief scientists: Matthew Church (University of Hawaii) and Ricardo Letelier (Oregon State University)

Objectives: Investigating the responses of ocean diazotrophs to variations in seawater $p\text{CO}_2$ - characterize the distributions and population dynamics associated with eukaryotic phytoplankton in the North Pacific Subtropical Gyre

Responsibilities: Study the kinetics of ATP and DIP utilization at the bulk and single-cell levels. Study the effect of light on ATP and DIP utilization within the main microplankton taxa present in the North Pacific Subtropical Gyre.

“Quorum-sensing and the carbon cycle” (KM10-13), 16–23 July 2010

Chief scientist: Benjamin Van Mooy (Woods Hole Oceanographic Institution)

Objectives: Identifying cell-density dependent organic carbon degradation among marine bacteria in sinking particles.

Responsibilities: Characterize the plasticity of microorganisms P utilization pathways in various N:P ratios scenarios. Measure single-cell ATP and DIP utilisation rates, P stocks concentrations (DIP, total dissolved P, particulate P, ATP). Supervise the project of an undergraduate student (Noel Hakoda). Test a method recently reevaluated for the measurement of ATP turnover rates and the identification of the biologically available stocks of phosphorus.

Website: <http://qscruise.blogspot.com/p/meet-crew.html>

MayHEM (Helping Educate about Microbes in May), 24–28 May 2010.

Chief scientists: Kimberley Weersing, Samuel Wilson (University of Hawaii)

Objectives: Teach undergraduate and high school teacher oceanography methods and work at sea.

Responsibilities: Characterize the activity of ectoenzymes that hydrolyze organic carbon, nitrogen and phosphorus compounds in relation with the composition of dissolved inorganic and organic matter and bacterial diversity (TRFLP) in samples from perturbation experiments. Teach undergraduate students (William Truong and Noel Hakoda) the methods for work at sea.

POOB II (Pacific Open Ocean Bloom), 29 July–14 August 2009.

Chief scientists: Mark Brzezinski (University of California, Santa Barbara)

Objectives: Study silicon cycling during the summer diatom bloom in the North Pacific Ocean.

Responsibilities: Measurements of P stocks concentrations (DIP, total, size fractionated particulate P), size fractionated chlorophyll *a*, size fractionated DIP incorporation rates, kinetic parameters of DIP incorporation rates in size fractionated samples, ATP turnover rates, P pathways gene expression, bulk and cell-specific phosphatase activities.

OPEREX (Ocean PERTurbation EXperiment), 30 July–14 August 2008.

Chief scientists: Zbigniew Kolber (Monterey Bay Aquarium Research Institute), Allison Fong (university of Hawaii)

Objectives: To explore the potentials and limitations of perturbation experiments at sea.

Responsibilities: Measurements of bulk and cell-specific phosphatase activities. Processing flow cytometry samples to measure microplankton cell abundances.

Website: <http://cmore.soest.hawaii.edu/cruises/operex/index.htm>

POOB I (Pacific Open Ocean Bloom), 1–22 July 2008.

Chief scientists: Mark Brzezinski (University of California, Santa Barbara)

Objectives: Study silicon cycling during the summer diatom bloom in the North Pacific Ocean.

Responsibilities: Measurements of P stocks concentrations (dissolved inorganic (DIP), total, size fractionated particulate P), size fractionated chlorophyll *a*, size fractionated DIP and DIC incorporation rates, bulk and cell-specific phosphatase activities. On-deck incubation experiments to test the regulation of alkaline phosphatase activity.

HOT 200-201-206-216 cruises (Hawaii Ocean Time-Series), 2–6 November 2009, 28 November–2 December 2008, 26–30 May 2008, 22–26 February 2008.

Objectives: Scientists working on the Hawaii Ocean Time-Series (HOT) program have been making repeated observations of the hydrography, chemistry and biology of the water column at a station north of Oahu, Hawaii since October 1988. The objective of this research is to provide a comprehensive description of the ocean at a site representative of the North Pacific subtropical gyre. Cruises are made approximately once per month to the deep-water Station ALOHA (A Long-Term Oligotrophic Habitat Assessment; 22° 45'N, 158° 00'W) located 100 km north of Oahu, Hawaii. Measurements of the thermohaline structure, water column chemistry, currents, optical properties, primary production, plankton community structure, and rates of particle export are made on each cruise.

Responsibilities: Measurements of bulk and cell-specific phosphatase activities.

Website: http://hahana.soest.hawaii.edu/hot/hot_jgofs.html

BIOSOPE (Biogeochemistry and Optics South Pacific Experiment), October–December 2004.

Chief scientists: Hervé Claustre, Antoine Sciandra (Paris 6 University)

Objectives: The main objective of the BIOSOPE project was to study, during austral summer, the biological, biogeochemical and optical characteristics of different trophic regimes in the South East Pacific, and especially the oligotrophic area associated to the central part of the South Pacific Gyre (SPG). The second objective of the project was to develop or adapt methods in order to be able to quantify stocks or fluxes at levels close to detection limits, which are expected to be encountered in the highly oligotrophic conditions associated to the SPG. The third objective of the project dealt with a synthesis on the (biological, biogeochemical and optical) characteristics of various oligotrophic regime that have been studied (and will be studied here in the Pacific) as part of various JGOFS projects which were carried out during the last decade, in particular by the French community.

Responsibilities: Measurements of carbon and phosphate uptake rates, chlorophyll *a* and P stocks concentrations, bacterial production and ecto-enzymatic activities.

Website: http://www.obs-vlfr.fr/proof/vt/op/ec/biosope/bio_obj.htm

Fieldwork in lakes, rivers and wetlands

Sampling the 2021 volcanic eruption on the Reykjanes Peninsula, Iceland, Spring-Summer 2021

The goal of this time series sampling is to study the initial colonists of freshly emplaced volcanic rocks at high latitude and the community succession.

Collaborators: Christopher Hamilton (University of Arizona); Snædís Björnsdóttir, Snæbjörn Pálsson and Andri Stefánsson (University of Iceland).

Sampling of the Holuhraun ephemeral hot springs, Summer 2016

The Holuhraun eruption (2014–2015) generated a large flood lava flow, which inundated a segment of the Jökulsá á Fjöllum River, Iceland's highest discharge river, resulting in unusual forms of hydrothermal activity. We sampled the glacier river close to its source (the Vatnajökull glacier) and at several downstream locations after the lava flow. We also conducted incubation experiments to complement our observations and test the effects of rapid water temperature fluctuations on microbial communities' abundance, diversity and activity.

Collaborators: Christopher Hamilton (University of Arizona) and Snædís Björnsdóttir (University of Iceland).

Bronx River monitoring, Summer 2014

Monitoring (bi-monthly) of the Bronx River: temperature, pH, salinity, nutrients, cell abundances (bacteria and phytoplankton), chlorophyll, and pathogen indicator (Fecal indicators *Enterococcus*).

Collaborator: Damian Griffin (NYC Parks)

WLFE-1 (Water Level Fluctuations Experiments 1), Fall 2013

Series of experiments to test the effect of water level fluctuations on microbes and biogeochemical cycles in contrasted wetlands in the Great Lakes area.

Collaborators: Geraldine Nogaro and Alan Steinman, Annis Water Resources Institute (AWRI)

DYLACHEM (Dynamique Lacustre et Hétérogénéité Biogéochimique), Summer 2004.

Chief scientist: Eric Viollier (Paris 7 University). *Objectives:* quantify nutrients fluxes (carbon, nitrogen, phosphorus) between different compartments (sediment, hypolimnion and epilimnion) of a lake ecosystem to link physical, chemical and biological functioning. *Responsibilities:* Flow cytometry analysis of viruses, bacteria and picophytoplankton living in the water column and the sediments.

Professional activities

Ph.D. committee member

- Alba Filella (Mediterranean Institute of oceanography, France): ongoing
- Kailani Acosta (Columbia University, NY): ongoing

Ph.D. examiner

- Amber Paasch (American Museum of Natural History, NY): “Physiological and genomic characterization of phagocytosis in green algae”. Successfully defended in September 2017
- Daniel Diaz de Quijano i Barber (University of Barcelona, Spain): “On the track of cellular ecology. Methodological improvements and contributions of single-cell phosphatase activity on the ecology of phytoplankton in Pyrenean lakes. Successfully defended in July 2014

Master thesis examiner

- Cathryn Sephus (University of Arizona). Successfully defended in April 2021
- Nicholas Bock (Columbia University). Successfully defended in March 2018

Literature and Proposal reviews

- *Editorial Board:* Review Editor of Aquatic Microbiology (specialty section of Frontiers in Marine Science and Frontiers in Microbiology); Review Editor of Coevolution (specialty section of Frontiers in Ecology and Evolution); Guest Editor for a special volume on “Phosphorus Along the Soil-Freshwater-Ocean Continuum” in the journal Frontiers in Marine Science.
- *Journals:* Applied and Environmental Microbiology (2012 ×1); Aquatic Microbial Ecology (2020 ×2; 2011 ×1; 2009 ×1); Aquatic Sciences (2016 ×1); Biogeosciences (2014 ×2; 2013 ×1; 2011 ×1); Deep-Sea Research Part I (2010 ×1); ESA Ecological Monographs (2016 ×1); Environmental Earth Sciences (2015 ×1); Environmental Microbiology and Environmental Microbiology Reports (2015 ×1); Freshwater Biology (2017 ×2; 2016 ×1,); Frontiers in Aquatic Microbiology (2019 ×1; 2018 ×2; 2016 ×1; 2011 ×1,); Journal of Geophysical Research – Oceans (2015 ×1); Journal of Microbiological Methods (2011 ×1; 2010 ×2; 2009 ×1; 2008 ×2,); Journal of Phycology (2009 ×1); Journal of Plankton Research (2013 ×1); Journal of the Marine Biological Association UK (2016 ×1); Life (2020 ×1); Limnology and Oceanography (2019 ×1; 2018 ×1; 2017 ×3; 2012 ×1); Limnology and Oceanography: Methods (2018 ×1; 2013 ×1; 2012 ×1); Marine Chemistry (2012 ×2); Marine Ecology Progress Series (2014 ×1); Microbial Ecology (2014 ×1; 2011 ×1); Metallomics (2016 ×1); Nature Communications (2021 ×1); Nature – Scientific Reports (2020 ×1, 2018 ×1, 2016 ×1); PeerJ (2018 ×1); Science of the Total Environment (2013 ×1).
- *Grant proposal panel reviewer:* NSF (2017)
- *Grant proposal Ad-hoc reviewer:* NSF (2020 ×3; 2019 ×2; 2018 ×1; 2017 ×2; 2015 ×3; 2013 ×1); Geschäftsstelle des Gutachterpanels Forschungsschiffe (GPF, 2019 ×1); C-MORE EdVentures (2010 ×6); Joint German-Israeli Water Technology Research Program (2009 ×1).

- *Scholarship-Fellowship reviewer and jury*: Graduate Women in Science National Fellowships Program (2014-Reviewer); LDEO Provost's Diversity Postdoctoral Scholar Award (2013-Jury).

Institutional services

- 2021** University of Arizona: Committee to develop a key strategic partnership with Western Australia University
- 2020** University of Arizona: Ecology & Evolutionary Biology Faculty Search Committee
- Since 2019** University of Arizona: MCB Awards Committee
- Since 2019** University of Arizona: MCB TA Fellowship Application Review Committee
- 2013–2017** Columbia University: LDEO Promotions and Careers Sub-Committee.

Participation in working groups and session organization at international meetings

- 2021** Mixotrophs and Mixotrophy OCB Working group, elected official participant.
<https://www.us-ocb.org/mixotrophs-and-mixotrophy-working-group/>
- 2020** Led a session at the Ocean Sciences Meeting (February 2020, San Diego)
- Since 2018** Biosphere 2 Ocean (B2O) advisory committee
- 2018** Primary Productivity Working Group, the NASA PACE project (<https://pace.gsfc.nasa.gov/>), to establish standard, community-consensus field protocols for measuring aquatic Primary Productivity in coastal and ocean waters across diverse methodologies.
- 2016** 2nd Workshop on Environmental Controls of marine N₂ fixation: Present Knowledge and Future Challenges (Invitation Required). Ocean Sciences Meeting, New Orleans, LA.
- 2005** BASICS “Symposium on single-cell analysis of planktonic microbes”. University Paris 6, Banyuls Observatory.

Other

Societies

- American Society of Limnology and Oceanography (ASLO, <http://www.aslo.org/>), member
- American Geophysical Union (AGU, <http://www.agu.org/>), Life Membership
- American Society for Microbiology (ASM, <http://www.asm.org/>), member

Volunteer work

- Volunteer (2013 to 2019) for New York Cares (<https://www.newyorkcares.org/>)
- Volunteer (2010, 2011) for the Kokua Hawaii Foundation school programs (<http://www.kokuahawaiifoundation.org/>)
- Volunteer coordinator (1999) and director of summer group trips (2000, 2001, 2003) for “APF Evasion” association (Association for Paralyzed French persons, <http://www.apf.asso.fr>)

Languages

English (fluent), French (fluent), Spanish (scholar level)